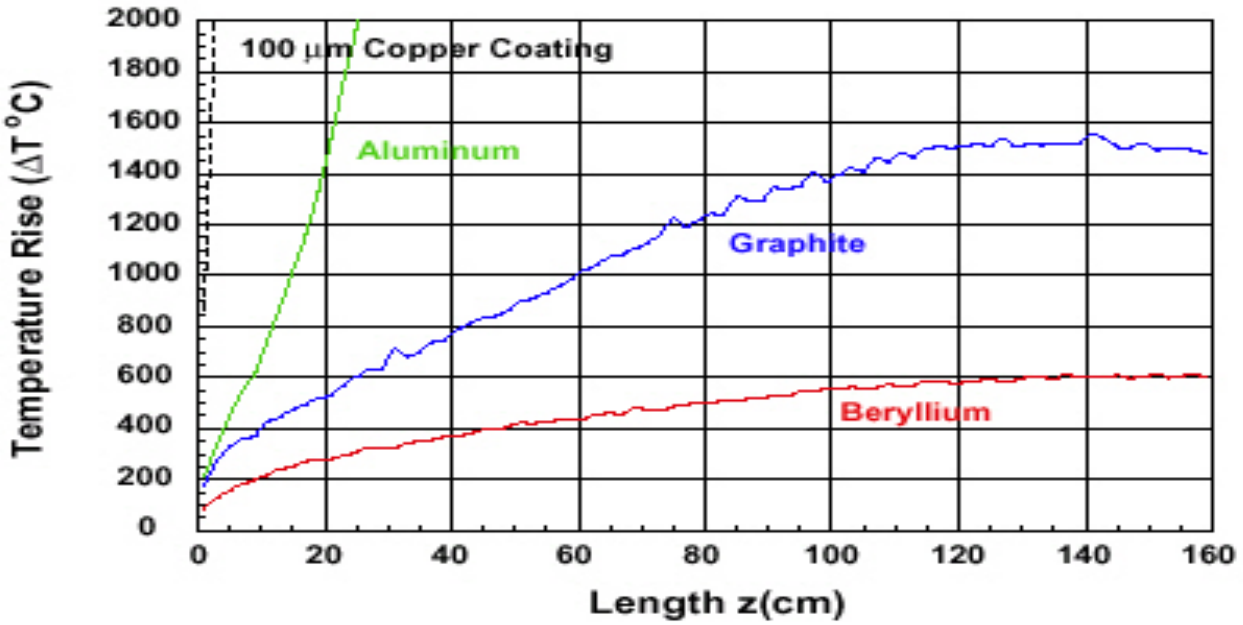
Comparison of LHC and SNS Collimator Impedance

9-8-03

I. LHC

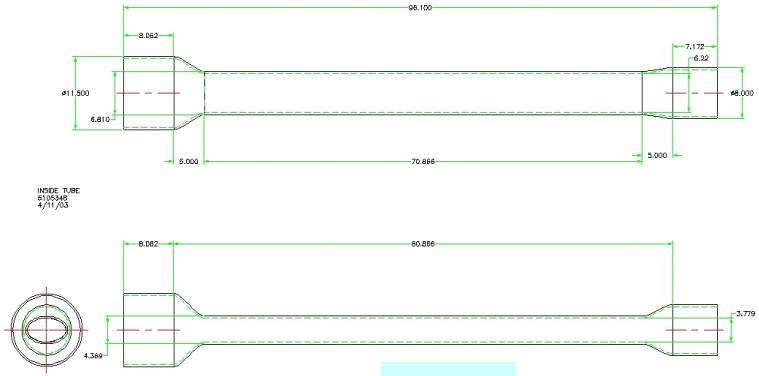
- There are 20 XY type betatron collimators per beam, 4 primary, 16 secondary.
- Primaries close at 5 to 6 σ, and secondaries 8 to 9 σ, where σ = 1 mm at injection and 0.2 mm at store.
- Study shows that copper or aluminum cannot be used for jaws, therefore, graphite is considered.



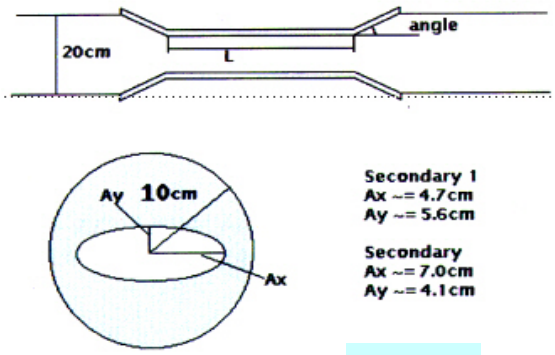
- **Broadband impedance is responsible for single bunch intabilities.**
- **The longitudinal impedance is Z/n = 4 m Ω, but for transverse impedance, a factor $2R/b^2$ and local β function made it to 2.3 MΩ/m. Total broadband impedance is 3.6 MΩ/m (D. Brandt et. al. EPAC02). Corresponding N*th* = 6.7e11 at top energy.**
- **This is for closing radius of 8 mm. Closing in at 2 mm results in 36 MΩ/m, ...**
- **Resistive wall impedance is responsible for coupled bunch instabilities.**
- **LHC required full range of tune choice, below and above integer. Transverse feedback system can handle 100 MΩ/m.**
- **With graphite jaws (resistivity 1.4e-5 Ωm vs. copper of 1.8e-8 Ωm), the resistive wall impedance at 8 kHz (for fractional tune 0.7) is 73 MΩ/m at injection, and 1127 MΩ/m at top.**
- **Still looking for solution: beryllium jaws, relaxing closeness, copper doped graphite, ...**

II. SNS

- 1 primary, 2 secondaries. Design slightly modified.
- Broadband impedance: longitudinal Z/n = j 0.22 Ω [Kurennoy simulation: j 0.19 Ω], transverse j 2 kΩ/m. Note that total broadband impedance is j 9 Ω, and j 60 kΩ/m, respectively. [Impedance budget, J. Wei, ASAC, Sep. 2002]
- Resistive wall impedance at the revolution frequency:
- Longitudinal impedance is about 5% of the total ring impedance of (1+j) 0.65 Ω, i.e. it is (1+j) 0.04 Ω. [Impedance budget, ring total (1+j) 0.71 Ω]
- Transverse impedance is about 34% (factor of $1/b^3$) of the total ring wall impedance of (1+j) 5.22 kΩ/m, i.e., it is (1+j) 1.78 kΩ/m. [Impedance budget, ring total (1+j) 8.5 kΩ/m]



2003



2000